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AND DEVELOPMENT OF A LOAD CARRIAGE PERFORMANCE ANALYSIS
MODEL**

**SUBTITLE: The Effect of Chemical Defense Measures of Sustained
Military Operations**

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FOREWORD

For the protection of human subjects, the investigator(s) have adhered to policies of applicable Federal Law 45CFR56.

Citations of commercial organizations and trade names in this report do not constitute an official Department of the Army endorsement or approval of the products or services of these organizations.

A. TECHNICAL OBJECTIVE (U): Maintenance and/or enhancement of performance during sustained operations (SUSOPS) is of vital concern to all military services, and if possible may contribute to the successful outcome of conflicts. Adding the contingency of an NBC defensive posture in hot environments during SUSOPS significantly increases logistics, tactical and medical requirements. The purpose of this work unit was to quantify Marine Corps combatant cognitive and physical performance changes as a function of sustained mental and physical work with drug (antihistamines), sleep loss and Individual Protective Ensembles (IPE) as measured by the Tri-Service Cognitive and Physiological Performance Assessment Batteries (PABs).

B. APPROACH (U): A series of studies delineated into five phases were conducted in either laboratory or controlled field environments. Marine Corps and highly fit civilian volunteers performed cognitive and physical tasks in simulations of sustained reconnaissance missions in which a number of complicating factors and conditions were progressively added and measured. These manipulated factors were various levels of respiratory, circadian, thermoregulatory, sleep loss, workload, fitness, drug and clothing (various MOPP levels). When appropriate either between or within group repeated measures designs were utilized. The effects were measured by established medical, psychological and physiological methods as described in Tri-service PABs that were developed by the Army's Chemical Defense Program of which this project was a part.

C. PROGRESS (U):

Description of the work

1. Phase 1-A: This lab study investigated respiratory muscle and respiratory air flow changes as a function of the M17A2 protective gas mask. All subsequent phases have measured effects on breathing patterns and oxygen consumption characteristics, body temperature, heart rate, and cognitive task performance.

2. Phase 1-B: This lab study investigated the effects of wearing the M17A2 gas mask during 4-hour episodes of non-exercise continuous work.

3. Phase 2: This lab study investigated the effects of wearing a complete chemical defense ensemble during 12-hour episodes of non-exercise continuous work.

4. Phase 3: This lab study investigated the effects of wearing a complete chemical

defense ensemble for up to 12 hours of intermittent exercise during a series of incremental workloads (walking at 3 mph on a flat treadmill while carrying 0, 25, 50, or 75% of body weight).

5. Phase 4: This field study investigated the effects of MOPP 4 level IPE with a load carry of 50% body weight on intermittent continuous work (25 mile distance) without sleep over a 40 hour period.

6. Phase 5: This field study followed the same protocol as phase 4 except that calibrated doses of diphenhydramine were administered to marine corps participants over the course of the continuous work.

Work Accomplished Since last Report Period

The work associated with this contract consists of performing studies, data analysis and report writing. All studies have been completed. All data from phases 1-3 have been analyzed and reported. Cognitive data from phases 4 and 5 have been reported and has been the responsibility of Dr. Diane Williams of NHRC. Physiological data from those studies is still being analyzed and has been the responsibility of Dr. Anthony Sucec of San Diego State University.

The Cognitive PAB data from phases 4 and 5 data were first analyzed to determine percent correct and reaction time for each of the 13 tasks used. The results of this analysis were presented at the 1990 American Psychological Association Annual Meeting. In performing these analyses, it became clear that the data set included some points that were outside the range of the typical points. These points were either introduced in converting the data from one format to another, or represented times when the subjects were not doing the tasks. Consequently, the data were analyzed a second time in a more detailed manner. This second data analysis is still continuing. The anomalous points have been eliminated by requiring each point to be within three standard deviations of the mean for that subjects, for that task, in that session. This has eliminated exceptionally slow or exceptionally fast reaction times.

The second measure that was taken was to look at the reaction times for the correct responses separately from the incorrect response reaction times. The rationale here is that the subjects may well be doing a different task when their performance is accurate than when their performance is not. A review of the literature on fatigue revealed the importance of looking at excessive reaction times separately from normal ones. These excessive reaction times or lapses in performance were operationally defined to be any RT that was more than twice the mean RT.

We decided to investigate all the dependent measures that we could conceive of in order to examine their relative sensitivity to the stressors, and their relative stability over small changes in the task. These 12 dependent measures were mean RT, mean RT for correct response, mean RT for incorrect responses, mean RT for correct lapses, mean RT for incorrect lapses, number of correct lapses, total number of lapses, percent correct responses, and percent of correct lapses. Another dependent measure will be added will be added to those already used. This measure is number correct/minute. This is similar to the metric used in assessing typing performance and has the virtue of combining accuracy and speed in a single metric.

At this point, the 13 PAB tasks have all been analyzed on all 12 of the dependent measures, and the significant effects have been graphed. However, the relative effectiveness of the dependent measures has not been determined. A factor analysis of the reaction time data for correct responses has

been conducted to determine the relationship among the cognitive functions assessed by the various PAB tasks. This analysis resulted in four factors which grouped the tasks differently than we would have expected.

There were three mood questionnaires used in the 4/5 studies. The data from these different questionnaires has been analyzed. These data are now being subjected to a factor analysis in order to determine the relationship among the scales used in the three different mood tests.

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